United States
Department of
Agriculture

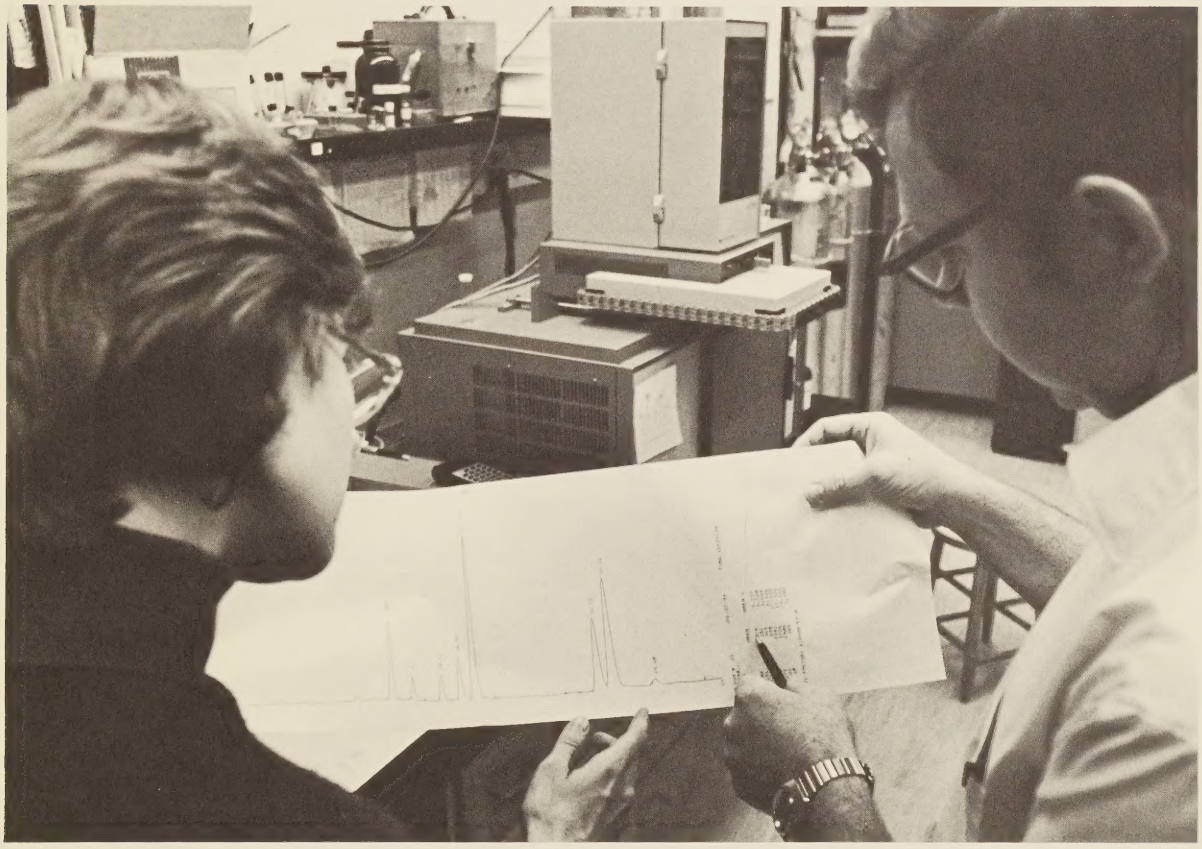
Forest Service

Forest
Products
Laboratory

January through
June 1981

Dividends From Wood Research

Recent Publications



Contents

About the cover:

FPL scientists are leaders in the elucidation of the chemistry of naval stores components and in the development of analytical methodology. FPL chromatographic systems now greatly improve the analysis of rosin and tall oil components.

Dividends From Wood Research

"Dividends From Wood Research" is a semiannual listing of recent publications resulting from wood utilization research at the Forest Products Laboratory. These publications are made available to the public to encourage private and commercial application of Forest Service research. The Forest Products Laboratory is maintained in Madison, Wisconsin, by the Forest Service, U.S. Department of Agriculture, in cooperation with the University of Wisconsin.

Research Highlights

1 **Biological Utilization of Wood for Production of Chemicals and Foodstuffs**

Hajny, George J.

USDA For. Serv. Res. Pap. FPL 385, 1981

Solar energy and photosynthetic processes will in time be humanity's major source of energy and materials, predicts this paper's author. Use of solar energy can take many forms, but of particular interest is renewable photosynthetic material (plant material) for production of organic chemicals, especially ethyl alcohol. Wood is the most abundant renewable source for this material on earth, yet it is now largely used only for structural material or as a fiber source. Large quantities of wood residues produced during harvesting and in processing still go unused.

This paper reviews nearly 70 years of FPL work that has sucessfully converted wood residues to fermentation chemicals, including ethyl alcohol, to foodstuffs such as molasses and yeast, and to wood modified to be digestible by cows, sheep, and goats. These uses of wood are now economically marginal but hold genuine potential.

2 Cutting Yields from Standard Hardwood Lumber Grades When Gang Ripping

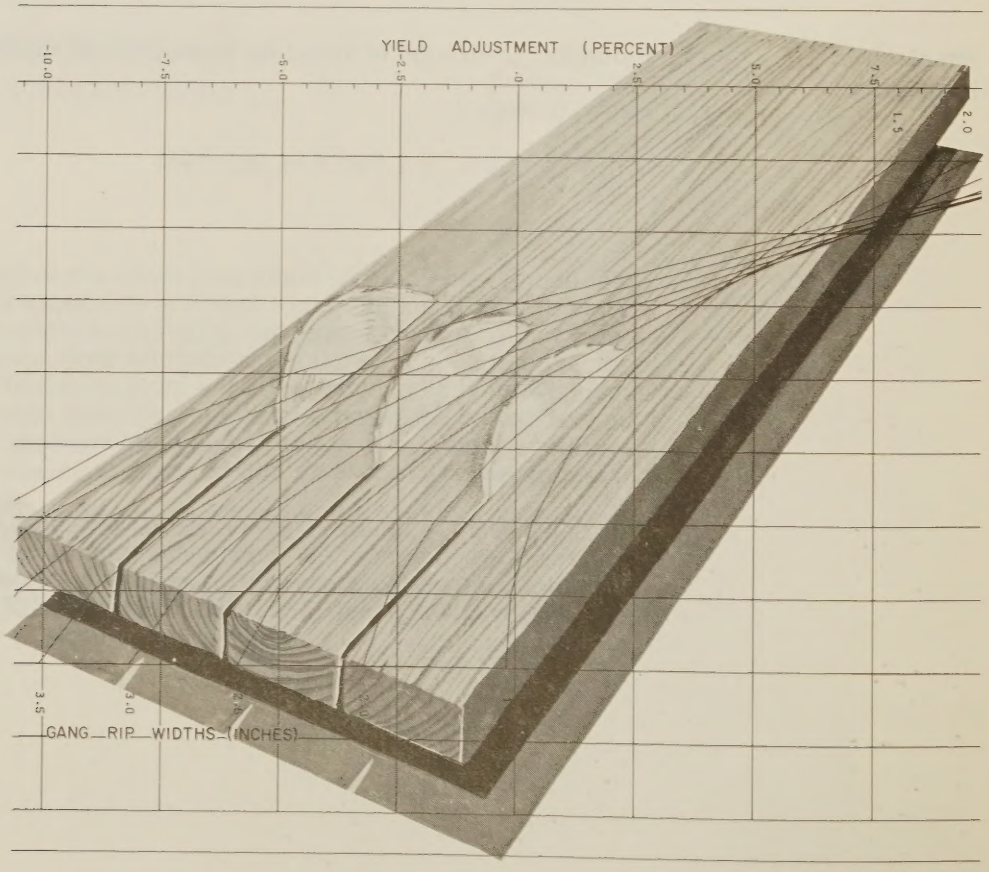
Hallock, Hiram

USDA For. Serv. Res. Pap. FPL 370, 1980

This paper contains charts (nomograms) for predicting furniture cutting yields from hardwood lumber graded by standard National Hardwood Lumber Association grades when the lumber is processed by gang ripping instead of conventional crosscutting. Gang ripping assumes that cuttings of any given length will be edge glued into panels and subsequently ripped (cut parallel to the grain) into desired widths.

Yields shown in the charts include the full ripped width, specified length cuttings, and salvage cuttings 1 inch and wider of the specified length. Allowance for losses in ripping the specified width cutting from the glued-up panel has been made. Complete instructions and examples are included for using the charts.

Readers should be familiar with the contents of Research Paper FPL 369, "Does Gang Ripping Hold the Potential for Higher Clear Cutting Yields?" published previously.



3 **Accelerating the Kiln Drying of Oak**

Simpson, William T.

USDA For. Serv. Res. Pap. FPL 378, 1980

When kiln drying time for lumber is reduced, so are energy needs and lumber inventories.

This paper discusses the results of research directed at kiln drying oak lumber faster than usual. Accelerating techniques used were presurfacing, presteaming, accelerated and smooth schedule, and high-temperature drying below 18 percent moisture content.

Results are compared with those achieved by conventional kiln drying. Drying time in the combined techniques procedures was reduced by more than 90 percent. The results for quality of the lumber were mixed. In most of the material, the quality was acceptable, but some of the oak lumber would not tolerate the rapid drying without excessive surface checking and honeycomb. The authors recommend that future work in accelerating schedules be aimed at identifying those properties or conditions that account for this intolerance to rapid drying in some oak lumber.

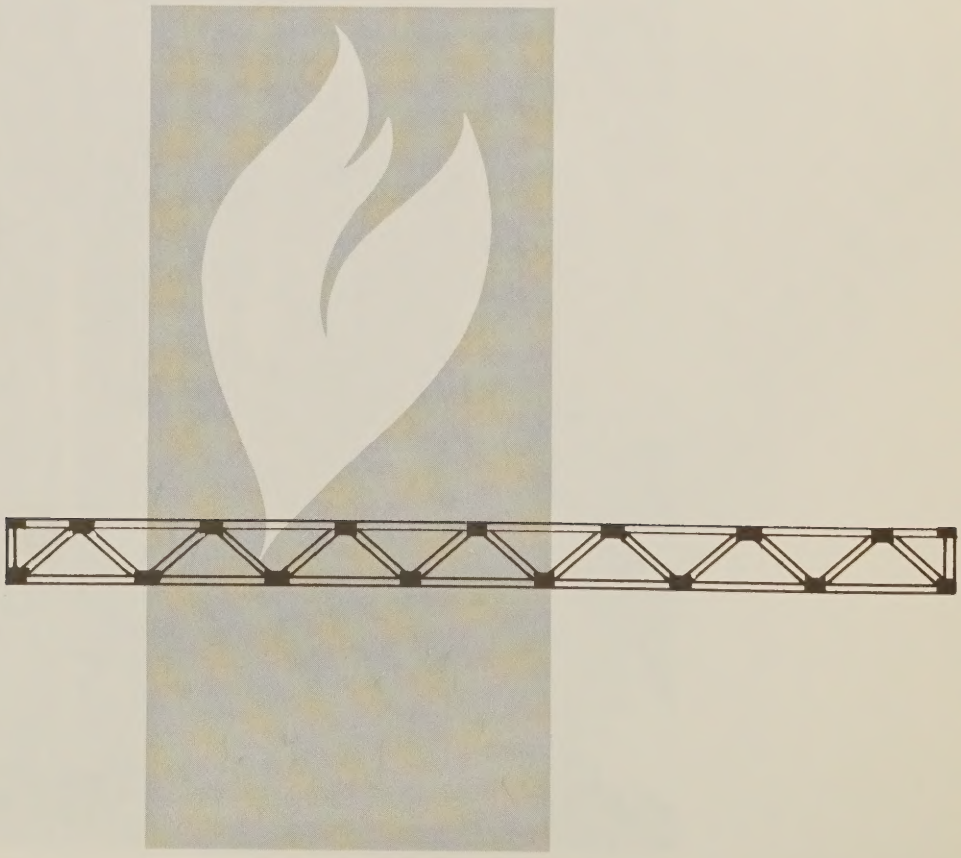
4 Reliability Analysis of Fire-Exposed Light-Frame Wood Floor Assemblies

Woeste, F. E. and E. L. Schaffer

USDA For. Serv. Res. Pap. FPL 386, 1981

The effectiveness of walls, floors, and ceiling roofs as barriers to fire growth is measured by using the American Society for Testing and Materials fire endurance test. One of several shortcomings in this present evaluation and rating system is that it does not realistically measure the fire safety afforded by assemblies. It simply compares the fire performance of one assembly with that of another by using a single-performance measure—a single test of each assembly to measure its fire endurance under a standard fire condition. A need exists for a measure of the risk associated with an event occurring.

This paper proposes a risk-based methodology and applies it for assessing the fire-endurance safety of two unprotected wood floor assemblies—the conventional wood joist and a floor-truss assembly. It also describes a method by which new components could be introduced into the market. The underlying premise is that a new component can be substituted for a conventional and code-acceptable component if it provides the same "degree of safety" when exposed to natural elements such as fire, earthquake, snow, wind, etc.



5 Hardwood Structural Particleboard for Industrial/Commercial Roof Decking

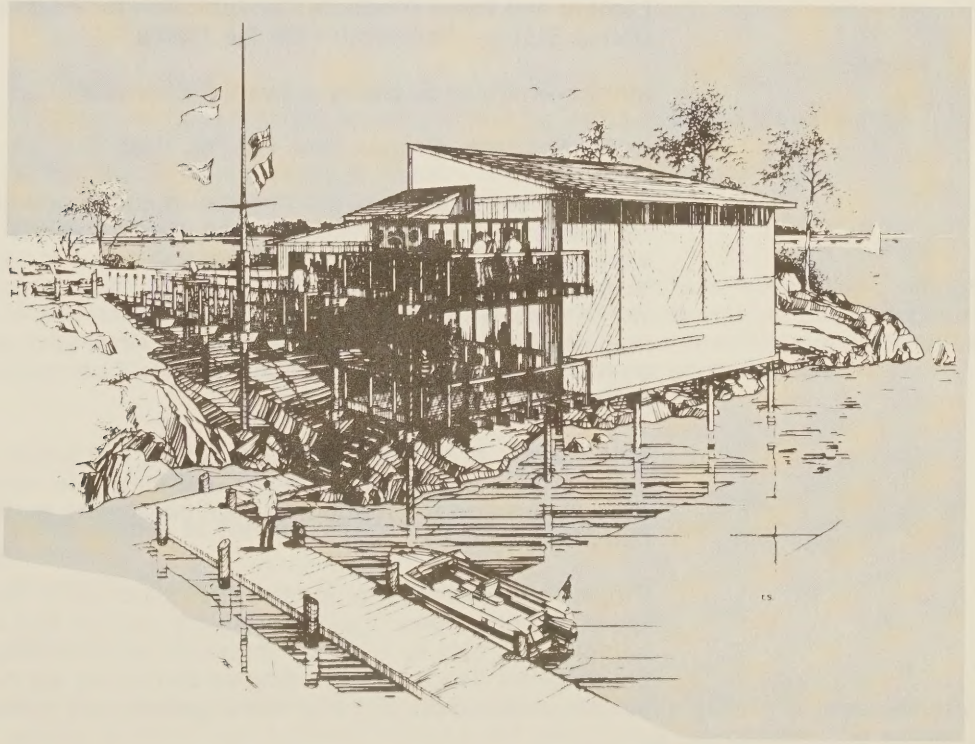
Hunt, Michael O., William L. Hoover, David A. Fergus, and William F. Lehmann

From: The Role of Chemical Engineering in Utilizing the Nation's Forest Resources, pp. 43-56, George R. Lightsey, ed., Am. Inst. of Chem. Eng., Symp. Ser. No. 195, vol. 76, 1980

Recent timber demand-supply projections indicate that demand for softwood timber will continue to rise more rapidly than supply through the year 2000. In contrast, hardwood timber supplies are projected to rise more rapidly than hardwood demand. However, much of this inventory is in small size trees, including low quality and defective trees that are particularly abundant in the Eastern States.

Structural particleboard offers a new use of eastern hardwoods for industrial/commercial roof decking. To identify the market opportunities for such a product, a cooperative research project between Purdue University and the Forest Products Laboratory was initiated in 1975. This paper reports on the results and conclusions of this project.

Using conventional equipment and conventional processing, project researchers were able to make a structural particleboard for use as roof decking from 100 percent high-density red oak. The product satisfied the design constraints for structural adequacy (EI), and panel weight. Compared to ribbed steel decking, roof decking made from red oak has a lower relative inflation rate and improved thermal insulation properties. Red oak also grows abundantly in the eastern market area and is relatively cheap.



6 **Dimensional Stabilization of Wood in Use**

Rowell, Roger M. and Robert L. Youngs

USDA For. Serv. Res. Note FPL-0243, 1981

Wood swells when wet. Or in the words of the chemist, when moisture comes into contact with wood, the water molecules penetrate the cell wall and become bound to cell wall components through hydrogen bonding. Wood's tendency to change dimensions on contact with moisture has caused problems with its use throughout history.

This report reviews treatments to minimize this tendency, and it makes recommendations for future research in this area. The basic types of wood treatments discussed are: (1) those which reduce the rate of water absorption but do little to reduce the extent of swelling and (2) those which reduce the extent of swelling but may or may not reduce the rate of water absorption. In the former, the treatment types discussed are application of internal or external water-resistent coatings and reduction of the tendency of wood to take on water (reduced hygroscopicity). The latter type of treatments discussed include mechanical restraints by cross-laminating (i.e. plywood), chemically cross-linking cell wall components of the wood, and "bulking" the wood cell walls with chemicals.

Also listed are eight very general recommendations for future research pertaining to broad research areas.

7 **Lumber and Panel Products Consumption for Packaging and Shipping in the United States—Perspective for the 1980's**

McKeever, David B. and H. Edward Dickerhoof

USDA For. Serv. Resour. Bull. FPL 10, 1980

In the United States, the distribution of goods provides many opportunities for growth in the use of wood-based panel products for packaging, warehousing, and shipping. The major impetus for growth in these distribution-related markets has been the manufacture of pallets, an industry which uses lumber as the dominant material. In the smaller containers market, wood use has steadily declined since 1948 as shippers try to reduce costs by increasing the use of corrugated fiber products and by developing lighter weight containers.

This bulletin examines the trends in past and future demand for lumber and panel products used in packaging and materials handling. The authors limit their discussion to plywood, veneer, hardboard, particleboard, and medium-density fiberboard.

Projections are made for lumber and board use in the 1980's. Any changes in types and quantities of wood products used in this decade for packaging and shipping are said to hinge on innovations and changing technologies in palletization. The new technologies discussed are molded particleboard pallets, medium-density fiberboard pallets, and plywood pallets.

Adhesives

8 **Formaldehyde Emission: Methods of Measurement and Effects of Several Particleboard Variables**

Myers, George E. and Muneo Nagaoka

Wood Sci. 13(3):140-150, 1981

Air contamination by formaldehyde in buildings containing urea-formaldehyde-bonded wood panel products has become an increasing concern. Recent FPL efforts include an experimental program that (1) evaluates methods to measure formaldehyde emission; (2) considers approaches for reducing air contamination; and (3) tries to relate emission data from laboratory tests to conditions in dwellings. Initial results are described here.

9 **Precision of Rate-Process Method for Predicting Durability of Adhesive Bonds**

Millett, M. A., R. H. Gillespie, and A. J. Baker

Durability of Building Materials and Components, ASTM STP 691, pp. 913-923, P. J. Sereda and G. G. Litvan, eds., Am. Soc. for Test. and Mater., 1980

Increasing use of wood products such as particleboard requires high-strength, durable adhesives. Thus, there is a corresponding need for short-term accelerated test procedures, such as rate-process, that assess long-term adhesive performance as well as initial acceptibility of wood adhesive systems. This report summarizes the precision of service-life predictions derived from the rate-process procedure.

Anatomy & Properties

10 **A Chemical Spot-Test for Aluminum and Its Value in Wood Identification**

Kukachka, B. F. and Regis B. Miller

IAWA Bull. 1(3):104-109, 1980

A solution of chrome azural-S in a spot-test for aluminum has proved a useful adjunct to classical wood identification. A positive reaction (bright blue color) immediately places an unknown wood specimen into one of about 19 families. Hand lens examination then will usually point to the proper family.

11 **Silica Bodies in Wood of Arborescent Leguminosae**

Koeppen, Robert C.

IAWA Bull. 1(4):180-184, 1980

The wood anatomist is often frustrated because many genera of legumes are similar in both their external features and anatomical characters. The author

discusses the taxonomic significance of the silica bodies found only in eight genera of the Family Caesalpinoideae, and presents a wood anatomical key to these silica-accumulating Leguminosae.

12 **Evaluation of Lumber Properties in the United States and Their Application to Structural Research**

Galligan, William L., David W. Green, David S. Gromala, and James H. Haskell

For. Prod. J. 30(10):45-51, 1980

Recent evaluations show that while houses as a unit are generally overdesigned, some individual structural components do not meet required strength values. These findings have prompted questions about the reliability of lumber properties. Goals cited here are for a major cooperative research effort on structural properties of lumber—what is called the "in-grade" testing plan for the United States.

13 **Development of Standardized Concepts for Assignment and Assessment of the Mechanical Properties of Lumber: A Continuing Challenge for the 1980's**

Galligan, William L. and David W. Green

For. Prod. J. 30(9):39-46, 1980

Efficient structural use of wood depends upon standard evaluation procedures that are relevant to the end performance requirements of the wood being evaluated. These authors discuss potential solutions for the decision-making dilemmas that confront stress grading of lumber in the 1980's. These issues include alternative evaluation concepts, near-minimum properties, acceptance judgments, outlying observations, and guidelines to temper statistical tests.

14 **Properties of Seven Colombian Woods**

Bendtsen, B. Alan and Martin Chudnoff

USDA For. Serv. Res. Note FPL-0242, 1981

Woods from abroad are an important raw material to the forest products industries in the United States. But effective utilization of this resource is hampered by the lack of technical information on many species. This report outlines mechanical properties of small, clear specimens of seven Colombian woods, an evaluation supplemented by information gleaned from world literature concerning other wood properties also important to effective utilization.

15 **Transient Moisture Gradient in Fire-Exposed Wood Slab**

White, Robert H. and E. L. Schaffer

Wood and Fiber 13(1):17-38, 1981

As with most wood properties, the existence of moisture affects fire performance. This study obtained data on the transient moisture gradient in a wood slab subjected to fire on one face. Results are shown as time-moisture content curves for different locations within fire-exposed wood slabs. Peak moisture movement appeared when temperature of the wood was about 100 °C.

16 **Temperature-Time Dependency of Longitudinal Mechanical Behavior of Dry Douglas-fir**

Schaffer, E. L.

From: General Constitutive Relations for Wood and Wood-Based Materials, pp. 234-278, Syracuse Univ., 1980

Predicting the way wood members might lose strength and deform when exposed to fire is important in fire research. For temperatures of 25° to 290 °C in dry Douglas-fir, the author investigated tensile-compressive strength change, creep rupture, and creep deformation as a basis for eventual structural analysis of large, fire-exposed wood members.

17 **Wood Anatomy of the Vochysiaceae**

Quirk, J. T.

IAWA Bull. 1(4):172-179, 1980

There has been no anatomically based key separating the six genera of the family Vochysiaceae. Yet, some are characteristic genera of the lowland rain forest in Middle and South America. This report presents such a key based on reliable xylem features of ray type and proportions. A second report will present anatomical data and ecological factors.

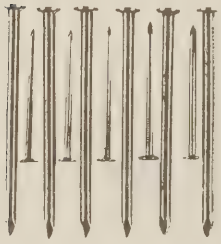
18 **Wood Identification Via Computer**

Miller, Regis B.

IAWA Bull. 1(4):154-160, 1980

Computerized wood identification is a flexible tool to add to present-day techniques. It is especially useful for difficult samples and the inexperienced anatomist. The author reviews other procedures used in wood identification and describes a computer program (IDENT 4) adapted especially for it. The discussion references IAWA Committee work towards a standard character list suitable for computerized hardwood identification.

Buildings & Construction



19 **Structural Continuity and Component Interaction**

Gromala, David S., William J. McCutcheon, Roger L. Tuomi, and Ronald W. Wolfe

From: Metal Plate Wood Truss Conference, pp. 138-144, William L. Galligan ed., For. Prod. Res. Soc., Madison, Wis., 1981

Examinations of house damage in disaster areas have indicated that the intercomponent connections between framing members and structural sheathings are usually the weakest links in the light-frame system; reinforcement of these connections can enhance component interactions. Research outlined here is being conducted to define and quantify the composite behavior and interaction of light-frame floors, walls, and roofs and to develop improved design methods that accurately account for overall structural performance.

20 **The Truss-Framed System for Residential and Light Commercial Buildings**

Tuomi, Roger L.

South. Lbrmn., Dec. 15, 1980

The truss-framed system (TFS) overcomes conventional construction weakness in connections between floor and wall and wall and roof by a unitized frame that provides structural continuity from the foundation up through the roof. TFS offers economical quality construction, design flexibility, fast erection, and added safety. This paper outlines TFS and its development at the Forest Products Laboratory.

21 **Moisture Interactions in Light-Frame Housing: A Review**

Schaffer, E. L.

Building Air Change Rate and Infiltration Measurement, ASTM STP 719, Am. Soc. for Test. and Mater. pp. 125-143, 1980

About 44 percent of the energy cost for operating a home is directly influenced by design and construction, including interior moisture. This paper examines the effectiveness of various proposed moisture or air infiltration controls on livability, safety, durability, maintainability, and structural behavior. The discussion illustrates performance advantages and disadvantages as a guide for researchers, designers, and builders of frame residences.

22 **Trends in Lumber Used for Housing**

Marcin, Thomas C. and Henry Spelter

From: Metal Plate Wood Truss Conference, pp. 173-180, William L. Galligan, ed., For. Prod. Res. Soc., Madison, Wis., 1981

Wood use trends in residential construction during the last 30 years involve

changing housing characteristics in framing, flooring, amenities, sheathing, and truss use. While the proportion and nature of building materials used in residential construction have changed since 1950, wood products remain dominant. Better utilization through improved truss-frame systems would enhance wood's competitive position with other materials.

Chemistry

23 **Tall Oil Precursors of Douglas-fir**

Foster, Daniel O., Duane F. Zinkel, and Anthony H. Conner

Tappi 63(12):103-105, 1980

Douglas-fir is the major conifer species used by many kraft (pulp) mills in the western United States and Canada. Thus, it is an important determinant of the quality of tall oil from those mills that is a source of commercially valuable fatty and resin acids. This is the first study to compare tall oil precursors in fresh wood and composition changes resulting from pulping.

24 **Decahydro-7-oxo-6aβ-methylcyclopental[f] [1]benzopyran-2-carboxylic Acid—A Metabolite Formed from Sterols by** *Nocardia* Species

Conner, Anthony H., Richard R. Koepsel, D. Perlman, Robert B. Bates, and George R. Kriek

J. of Appl. Biochem. 2:247-255, 1980

Tall oil, a by-product of the kraft (sulfate) pulping of pinewood, contains about 3 percent phytosterols, substances that may be potentially useful starting material for steroid drug production. To demonstrate this possibility the authors examined microbial degradation of phytosterols by a soil isolate. This paper reports identification by spectrometric and x-ray crystallographic methods of one product accumulating during the microbial fermentation.

25 **Tall Oil Precursors and Turpentine in Black and White Spruce**

Conner, Anthony H., Marilyn A. Diehl, and John W. Rowe

Wood Sci. 13(2):111-116, 1980

Additional sources of naval stores such as tall oil and turpentine are needed because of increasing demand for renewable resources. By inducing lightwood (oleoresin-soaked wood) in southern pines, paraquat increases the amount of tall oil precursors in the wood. This paper reports on the chemical composition of naval stores present in white and black spruce before and after paraquat treatment.

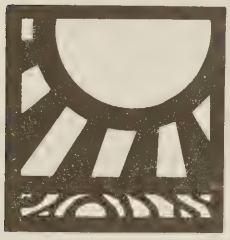
26 **Effects of Aqueous Sulfur Dioxide on Cellulose**

Conner, Anthony H.

Biotechnol. Lett. 2(10):439-444, 1980

Lignin-encrusting cellulose fibers and the crystallinity of cellulose are two major deterrents to effective utilization of wood by enzymatic or chemical conversion processes. Pretreatment of wood with gaseous SO_2 under pressure for several hours at elevated temperature appears to enhance hydrolysis of cellulosics. The study reported here determined that SO_2 did not decrystallize cellulose as recently reported elsewhere.

Degradation & Protection



27 **In-Place Treatments for Control of Decay in Waterfront Structures**

Highley, Terry L.

For. Prod. J. 30(9):49-50, 1980

Wood in above-water portions of marine structures, even though pressure treated, is often subject to decay. Heartwood portions of creosoted Douglas-fir fender piles and large structural members with checks (or cracks) penetrating beyond the treated zone are particularly susceptible. This note reports 10-year results of cooperative experiments to eliminate deep check decay problems.

28 **Cellulose Degradation by Cellulose-Clearing and Noncellulose-Clearing Brown-Rot Fungi**

Highley, Terry L.

Appl. and Environ. Microbiol. 40(6):1145-1147, 1980

It is critical to understand how decay enzymes operate if we are to protect wood in use from fungal degradation by ways that are nontoxic and environmentally acceptable. The degradation processes here are particularly interesting because of how brown-rot fungi degrade cellulose in wood—rapid depolymerization at low weight loss—implying a nonenzymatic system.

29 ***Laetisaria arvalis* (Aphyllophorales, Corticiaceae): A Possible Biological Control Agent for *Rhizoctonia solani* and *Pythium* Species**

Burdsall, H. H., Jr., H. C. Hoch, M. G. Boosalis, and E. C. Setliff

Mycologia 72:728-736, 1980

Early studies indicated the isolate of *Laetisaria arvalis*, a soil-inhabiting basidiomycete, might be used as a biological control against damping-off

organisms, including the cause of a sugar beet root rot. This paper details the fungus from culture as a new species, providing descriptions and illustrations of the basidiocarps and cultures and a discussion of its potential importance.

30 **A Unique Polysaccharide- and Glycoside-Degrading Enzyme Complex from the Wood-Decay Fungus *Poria placenta***

Wolter, Karl E., Terry L. Highley, and Faye J. Evans

Biochemical and Biophysical Research Communications 97(4):1499-1504, 1980

The authors identify properties of extra-cellular polysaccharide- and glycoside-degrading enzymes produced by the brown-rot, wood-decay fungus, *Poria placenta.* It may prove useful that simple sugars do not repress production of polysaccharide-degrading enzymes produced by *P. placenta* because such repression by degradation products is a serious problem in converting wood biomass.

31 **Lignification as a Mechanism of Disease Resistance**

Vance, C. P., T. Kent Kirk, and R. T. Sherwood

Annu. Rev. Phytopathol. 18:259-288, 1980

Lignin is thought to be formed as a response to microbial penetration and mechanical damage, but its role in resistance to plant disease remains unresolved. The authors' objectives for this review were to: (a) Describe briefly the biosynthesis and structure of lignin, (b) discuss how lignin is measured, (c) summarize evidence for its formation as a resistance mechanism, and (d) suggest how lignin may be associated with specificity in disease resistance.

32 **Distribution of Reacted Chemicals in Southern Pine Modified with Methyl Isocyanate**

Rowell, Roger M.

Wood Sci. 13(2):102-110, 1980

Wood's dimensional stability and resistance to biological degradation have been greatly improved through chemical modification. Research reported here was conducted to determine (1) the distribution of reacted chemicals in the holocellulose (main food source for micro-organisms) and lignin fractions in cell walls of chemically modified wood, and (2) the dimensional stability each fraction requires to attain decay resistance.

33 **Metabolism of a Phenylcoumaran Substructure Lignin Model Compound in Ligninolytic Cultures of *Phanerochaete chrysoporium***

Nakatsubo, Fumiaki, T. Kent Kirk, Mikio Shimada, and Takayoshi Higuchi

Arch. of Microbiol. 128:416-420, 1981

Although lignin biodegradation is of central importance to the earth's carbon cycle, specific reactions involved remain unknown. The ligninolytic enzyme system in the wood decay fungus *Phanerochaete chrysoporium*, and presumably in other ligninolytic Basidiomycetes, apparently is not induced by lignin. Initial reactions in metabolism of a phenylcoumaran substructure model compound in ligninolytic cultures of *P. chrysoporium* are described here.

34 **The Status of *Calvatia cretacea* in Arctic and Alpine Tundra**

Miller, Orson K. Jr., Harold H. Burdsall, Jr., Gary A. Laursen, and Irving B. Sachs

Can. J. of Bot. 58(24):2533-2542, 1980

Species of *Calvatia cretacea* were collected while studying the higher fungi from arctic and alpine tundra in Alaska. However, many *Calvatia* specimens did not possess the combination of characters described for previously reported taxa. This study was initiated to identify the authors' collections and to evaluate characters used in delimiting the tundra *Calvatia* species. Development of the peridium, spores, and capillitium was also examined.

35 **The Fruiting and Development of *Rhodotus palmatus* in Culture**

Miller, Orson K. Jr., John G. Palmer, and Linnea S. Gillman

Mycotaxon 11(2):409-419, 1980

To properly interpret variation in characteristics of a given fungus species, the range in phenotypic responses must be studied. Without this type of investigation, changes in the shape, size, and pileus color of *Rhodotus palmatus* might be assumed to be differences between species, instead of responses of the fruiting body to varying light conditions, as determined here.

Design Data

36 **Strength of Fasteners in Parallel-Laminated Veneer**

Jung, Joseph and Judy Day

USDA For. Serv. Res. Pap. FPL 389, 1981

Parallel-laminated veneer (PLV) has potential advantages because its strength-reducing characteristics are dispersed. Earlier work, however, has suggested PLV fastening characteristics may be considerably reduced below those of solid sawn wood. This present study was designed to further explore PLV fastening characteristics including the effects of lathe checking and veneer thickness on PLV nail joint strength.

37 **Non-Linear Constitutive Relations for Wood**

Zahn, John J.

From: General Constitutive Relations for Wood and Wood-Based Materials, pp. 212-224, Syracuse Univ., 1980

Much research effort has focused on ultimate strength of clear wood beams. However, most wood beams are not clear (have defects) and fail in tension in a brittle, non-linear manner. The author discusses research needs in modeling non-linear behavior of stress fields around knots and in determining failure mechanisms of in-grade material affecting ultimate binding capacity.

38 **Assessment of Modification Factors for a Row of Bolts or Timber Connectors**

Wilkinson, Thomas Lee

USDA For. Serv. Res. Pap. FPL 376, 1980

When bolts or timber connectors are used in rows parallel to the direction of loading, there is an unequal load distribution among fasteners in the row. Thus, design load must apply a modification factor for this unequal distribution. This study was initiated to determine the adequacy of design procedures and underlying assumptions used to arrive at presently used modification factors.

39 **Tensile Strength of One-, Two-, and Three-Ply Glulam Members of 2 by 6 Douglas-fir**

Peterson, John, Glen Madson, and Russell C. Moody

For. Prod. J. 31(1):42-48, 1981

Because laminating disperses the strength-reducing characteristics of wood, laminated members perform better than single pieces of lumber. To better understand this laminating effect on tensile strength of Douglas-fir lumber, an

extensive study was conducted. This report documents study results and subsequent data analysis and will be useful in developing design stresses for glulam timber.

40 **Stacking Method for Long-Term Concentrated Load Testing of Floor Panels**

McNatt, J. Dobbin, Michael J. Superfesky, and Karl J. Kanvik

For. Prod. J. 30(9):47-48, 1980

Some of the most severe loading conditions for residential floor systems are concentrated loads during construction and occupancy. However, little information is published on long-term concentrated load testing. This study sought to develop a test method for measuring creep deflection of large floor panels under concentrated loading, that would not take up excessive laboratory space.

41 **Shear Strength of Wood Beams: A Weibull Analysis**

Liu, J. Y.

J. of Struc. Div., Proc. of Am. Soc. Civ. Eng., 106(ST10):2035-2052, 1980

Shear strength of wood derived from tests of small, clear, straight-grained specimens has been significantly higher than that calculated from tests of large beams failing in shear. The author reviews shear strength research seeking a satisfactory explanation of this disparity. A Weibull statistical model has been used here to estimate shear strength of large Douglas-fir beams.

General

42 **Residue Decay Processes and Associated Environmental Functions in Northern Rocky Mountain Forests**

Larsen, Michael J., Alan E. Harvey, and Martin F. Jurgensen

From: Environmental Consequences of Timber Harvesting in Rocky Mountain Coniferous Forests, pp. 157-174, USDA For. Serv. INT-90, Intermountain For. and Range Exp. Stn., Ogden, Utah, 1980

How much fiber can be removed from forest sites by harvest without short- or long-term deleterious consequences? The authors conclude that brown-rotted wood in coniferous ecosystems performs like humus and becomes increasingly important with site dryness. Significant impacts could occur from harvest or premature burn of small dimensional materials, which contain a quantity of nutrients.

43 **Microbial Processes Associated with Nitrogen Cycling in Northern Rocky Mountain Forest Soils**

Jurgensen, Martin F., Michael J. Larsen, and Alan E. Harvey

From: Environmental Consequences of Timber Harvesting in Rocky Mountain Coniferous Forests, pp. 175-188, USDA For. Serv., INT-90, Intermountain For. and Range Exp. Stn., Ogden, Utah 1980

Nitrogen is usually the soil nutrient that most limits forest productivity. The authors discuss direct nitrogen loss from harvest sites and subsequent chemical and physical changes that affect the soil microorganisms active in the nitrogen cycle. It is the biological decomposition of nitrogen-containing organic matter by soil microflora that makes soil nitrogen levels susceptible to modification by silvicultural practices.

44 **Biological Implications of Increasing Harvest Intensity on the Maintenance and Productivity of Forest Soils**

Harvey, Alan E., Martin F. Jurgensen, and Michael J. Larsen

From: Environmental Consequences of Timber Harvesting in Rocky Mountain Coniferous Forests, pp. 211-220, USDA For. Serv. INT-90, Intermountain For. and Range Exp. Stn., Ogden, Utah, 1980

The relationship of microorganisms to soil productivity is pivotal to application of management activities that alter the nature and quantity of surface soil composition. For that reason microorganism types most likely to be associated with forest tree growth were examined in several undisturbed and variously disturbed experimental sites. This report emphasizes the general implications of these studies to forest management.

45 **Ecology of Ectomycorrhizae in Northern Rocky Mountain Forests**

Harvey, Alan E., Michael J. Larsen, and Martin F. Jurgensen

From: Environmental Consequences of Timber Harvesting in Rocky Mountain Coniferous Forests, pp. 189-208, USDA For. Serv. INT-90, Intermountain For. and Range Exp. Stn., Ogden, Utah, 1980

Ectomycorrhizal fungi form intimate relationships with conifer roots that improve root systems' nutritional uptake from soil and increase their resistance to drought and disease-causing fungi. To grow in relatively infertile forest soils, conifers require adequate root colonization by such fungi. This report describes how well types of organic matter support abundant, active ectomycorrhizal roots in soil from a range of forest ecosystems.

46 **Partial Cut Harvesting and Ectomycorrhizae: Early Effects in Douglas-fir—Larch Forests of Western Montana**

Harvey, Alan E., Michael J. Larsen, and Martin F. Jurgensen

Canadian J. of For. Res. 10(3):436-440, 1980

Ectomycorrhizal associations strongly depend on environmental factors (soil moisture, temperature, acidity, fertility, and organic matter content) and host factors (sugar content of plant roots) that can be influenced by partial stand removal. The effects of partial stand cutting, combined with intensive fiber removal or underburning, have strong implications in forest management.

47 **Clearcut Harvesting and Ectomycorrhizae: Survival of Activity on Residual Roots and Influence on a Bordering Forest Stand in Western Montana**

Harvey, Alan E., Martin F. Jurgensen, and Michael J. Larsen

Canadian J. of For. Res. 10(3):300-303, 1980

This study was undertaken to determine (1) if active ectomycorrhizae on live residual root systems would persist long enough after clearcutting to serve as inoculum for regeneration and (2) whether active ectomycorrhizal roots from adjacent, uncut stands persist in, or invade clearcuts sufficiently to be of value as ectomycorrhizal inoculum for regeneration. The timber type was Douglas-fir—Larch.

48 **Renewable Resources: Will They Be Scarce in the Future?**

Tombaugh, Larry W. and Robert N. Stone

From: Through the 80's, Thinking Globally, Acting Locally, World Future Society, Washington, D.C., pp. 118-121, 1980

To reduce the title question to manageable size, the authors concentrated on goods and services provided by forests. Widely divergent future views are troublesome to the forest manager because it takes a long time to grow mature trees. The authors compare the image of the future guiding the forester with that portrayed by others.

49 **Prospective U.S. Wood Use Situation**

Stone, Robert N. and Robert B. Phelps

For. Prod. J. 30(10):51-56, 1980

Successful decision-making in natural resources requires an accurate prediction of future demands. The authors discuss major market trends in housing, nonresidential construction manufacturing, and shipping as well as wood and roundwood products demand, net imports, and use efficiency. Their projections are based on timber products consumption and resource statistics prepared for the Renewable Resources Assessment by the Forest Service, U.S. Department of Agriculture.

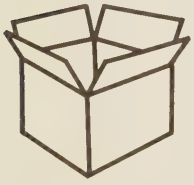
50 **Wood-Based Panel Products: A Changing Industry in the United States**

Stone, Robert N. and George A. McSwain

Unasylva 32(127):8-15, 1980

The fastest growing segment of world markets for wood products manufacturers is panels. This review of a changing industry outlines the new products, expanding markets, and innovations that will be influential in the future of wood panel products. Worldwide, a combination of favorable factors support an optimistic outlook for the 1980's.

Packaging



51 **Time Dependent Phenomena in Fiber-Based Materials**

Koning, John W. Jr.

From: General Constitutive Relations for Wood and Wood-Based Materials, pp. 182-187, Syracuse University, 1981

The author discusses creep characteristics of corrugated fiberboard containers when stacked in a warehouse, a problem that concerns performance of the container itself, rather than that of the combined board materials. Laboratory simulation, results of creep tests, and different analytical approaches are detailed, as well as the implication of recent findings using cyclic environments.

52 **Maximizing Top-To-Bottom Compression Strength**

Johnson, Millard W. Jr., Thomas J. Urbanik, and William E. Denniston

Paperboard Packag. 65(4):98-108, 1980

Determining the best fiber distribution in corrugated fiberboard could reduce the amount of fiber required to meet end-use conditions, and thus cut costs and extend the softwood timber supply. The authors analyze how to adjust facing and corrugating medium thicknesses to maximize the edgewise compressive strength per board weight.

53 **Development of an Improved Hardboard-Lumber Pallet Design**

Stern, Robert K.

USDA For. Serv. Res. Pap. FPL 387, 1980

Logging and sawmilling waste could be used for hardboard manufacture and subsequent pallet construction if the resulting pallets were competitive with existing lumber counterparts. This report describes results of using hardwood components to construct returnable, exterior-type pallets. All comparisons involving full-size pallets were based on the performance of the pallet types widely used in shipping today.

54 **Edgewise Compression Failure Mechanism of Linerboard Observed in a Dynamic Mode**

Sachs, I. B. and T. A. Kuster

Tappi 63(10):69-73, 1980

Corrugated fiberboard containers sometimes fail while stacked in warehouses, and studies have been made of the failure mechanism involved. The present study employs scanning electron, transmission electron, and light microscropy to explain how linerboard fails during edgewise loading in compression. These microscopic techniques indicate that the failure sequence starts from dislocation of cell wall tissues and leads to delamination and failure of the linerboard.

Processing

Drying

55 **Radio-Frequency Dielectric Drying of Short Lengths of Northern Red Oak**

Simpson, William T.

USDA For. Serv. Res. Pap. FPL 377, 1980

In today's market, drying hardwood boards after defects have been cut out offers attractive potential savings in energy and dryer capacity. This investigation concerns radio-frequency drying, which was found to have technical promise if used to obtain a 25-30 percent moisture content and then followed by more conventional finish drying.

56 **Sorption Theories Applied to Wood**

Simpson, William T.

Wood and Fiber 12(3):183-195, 1980

Numerous theories have been derived for sorption of gases on solids, many of which can be applied to how water is held in wood. This paper reviews the nature of sorption, sorption isotherms and thermodynamics, describes some of the theories, and presents some tests of those theories developed.

57 **Kiln-Drying Hardwood Dimension Parts**

Simpson, William T. and James G. Schroeder

USDA For. Serv. Res. Pap. FPL 388, 1980

Drying only usable hardwood cuttings instead of entire boards has advantages (such as reduced energy consumption) and disadvantages (such as increased warp). This study investigated effects of kiln schedule and end coating on quality in drying oak for interior frame parts of upholstered furniture. Warp was a particular problem.

58 **The Effect of Air Velocity on Reaching Dry Kiln Saturation Temperatures of Oak**

Bois, Paul J. and John L. Tschernitz

USDA For. Serv. For. Prod. Utilization Tech. Rep. 11, 1981

Oak is probably the most difficult native furniture species to kiln dry because it tends to check, honeycomb, and collapse. Yet it leads hardwood species in volume use. The authors review an area that research and discussion have neglected; design and use of proper kiln-drying equipment, particularly humidity conditions and uniform and adequate circulation of heat.

Sawing

59 **Yield Comparisons Between 4/4 Lumber and SDR Studs from Small Woods-Run Yellow-Poplar Logs**

Maeglin, Robert R., Erwin H. Bulgrin, and Hiram Hallock

For. Prod. J. 31(3):45-48, 1981

The Saw, Dry, and Rip (SDR) process developed by FPL allows manufacture of high-quality studs from small hardwoods such as surplus yellow-poplar. In a comparison of SDR and conventional sawing practices, SDR studs were superior in straightness. This report shows that the value and volume yields of these studs are greater than for 4/4 lumber from similar trees.

60 **Simulation of Hardwood Log Sawing**

Richards, D. B., W. K. Adkins, Hiram Hallock, and E. H. Bulgrin

USDA For. Sev. Res. Pap. FPL 355, 1979

Profitability of a hardwood sawmill operation depends upon making many correct and timely decisions to achieve highest practical lumber values. Described here is a completed step towards automation of these decision-making processes—the grading program for hardwood lumber developed by FPL. Given a mathematical description of a board with its defects, this program returns an accurate National Hardwood Lumber Association board grade.

61 **Trends in Softwood Sawmill Overruns and Their Impact on Stumpage Prices**

Spelter, Henry

For. Prod. J. 30(9):21-24, 1980

To estimate the value of a log for sawmilling, it is necessary to know its

potential lumber yield. The difference between predicted yield and actual yield is the overrun. But, in time, overrun values may be changing as changes occur in contributing variables. Some factors involved in those changes are documented here for widely used board foot log rules.

62 **Procedure and Computer Program to Calculate Machine Contribution to Sawmill Recovery**

Steele, Philip H., Hiram Hallock, and Stanford Lunstrum

USDA For. Serv. Res. Pap. FPL 383, 1981

Quality control studies at a sawmill to determine machine efficiency often overlook the contribution each machine makes to overall mill production. The authors introduce a method to assess these various contributions and follow it with an example in use. A FORTRAN computer program to make the necessary complex calculations automatically is also presented.

Grading

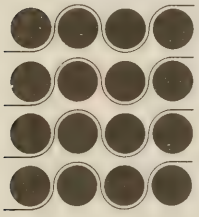
63 **Mills May Profit with MSR Grading**

Ince, Peter J., William L. Galligan, and Edwin Kallio

For. Ind. 107(11):56, 1980

Machine Stress Rating (MSR) is an alternative to visual lumber grading. The authors discuss how MSR can offer real economic advantages, particularly to high-volume sawmills where opportunities for new product markets and improved recovery are especially good, and where MSR grading costs can be spread over a large volume of lumber produced. Costs associated with representative MSR facilities are outlined.

Pulp & Paper



64 **Pulp Floc Stability of Hardwood-Softwood Mixtures**

Klungness, John H. and Donald J. Fahey

South. Pulp and Paper 43(12):37-39, 1980

High-density hardwoods are underutilized in linerboard manufacture because of poor drainage and strength. Drainage has been improved experimentally by adding chemicals in a low shear system. However, papermaking occurs under high shear conditions that may disrupt pulp flocs formed by additives and thus reduce drainage rates. This study investigated factors affecting stability of flocs formed by the dual polymer addition level found to be optimum at low shear levels.

65 **Hardwood Pulp Utilization: Separation of Nonfibrous Oak Components**

Klungness, J. H. and N. Sanyer

Tappi 64(2):109-113, 1980

Linerboard for corrugated fiberboard boxes is one of the most important fiber products manufactured in the South, a region where surplus oak is available for pulping. This study was to determine how a large proportion of parenchyma cells (fines) and large-diameter vessel elements affect use of oak pulp in papermaking by causing poor water removal and lowered paper strength.

66 **The Press Drying Concept for Papermaking**

Setterholm, Vance and Peter Ince

South. Lbrmn., Dec. 15, 1980

Press drying is a new papermaking process developed at FPL. By simultaneously pressing and drying a wood fiber web, this process produces high-strength papers from currently underutilized hardwoods, as well as softwoods. The authors outline why this conversion of hardwoods is possible with press drying and its potential to significantly increase the market for hardwoods.

67 **Fungal Decolorization of Kraft Bleach Plant Effluents**

Eaton, D., H-m. Chang, and T. K. Kirk

Tappi 63(10):103-106, 1980

Future pollution regulations will require that the pulp and paper industry substantially reduce the color in its wastewater. The authors investigated the feasibility of using white-rot fungi to degrade and metabolize lignin in bleach plant effluents. Lignin and its degradation products are a major color source in these effluents, which are in turn the major color source in the wastewater.

68 **FPL Press Drying Process: Wood Savings in Linerboard Manufacture**

Ince, Peter J.

Tappi 64(4):107-109, 1981

Press drying is a new FPL concept in papermaking that permits use of hardwood pulp in linerboard for corrugated boxes. With U.S. production of linerboard projected to increase, press drying promises considerable savings in wood cost. This preliminary economic report suggests actual savings will vary, depending on raw material prices and variable aspects of the process itself.

69 **Soda-Amine Pulping: A Warning about Phase Separations**

Obst, John R.

Tappi 64(3):171-172, 1981

Water-soluble amines have been used to accelerate delignification of wood, but recent studies provide a warning. In alkaline reaction of lignin models, a solution of dioxane in alkali was homogeneous at 20°C but formed two phases upon heating. A later study on lignin models in soda-amine liquors often gave two phases. If such phase separations are undetected, they could lead to erroneous interpretations of results.

Residues & Energy

70 **Gasohol from Wood Is Not Yet Economically Feasible**

Baker, Andrew J.

For. Farmer 40(2):21-22, 1980

Use of wood as a source of ethyl alcohol, which is added to gasoline to make gasohol, has received growing interest in the past several years. The reason: carbohydrates in wood can be changed into sugars by hydrolysis and then fermented into ethyl alcohol. The author outlines three types of hydrolysis under development, as well as current economic factors.

71 **Wood Residue Potential for Energy**

Zerbe, John I.

From: Proc. Bio-Energy '80—World Congress and Exposition, pp. 51-52, Bio-Energy Counc., Washington, D.C., 1980

If half the available but unused forest residues in the United States were harvested and used for fuel, either directly or through conversion to gas or liquid, they would contribute about 1/15 of the energy we use each year. However, the harvest must be economical and consider soil nutrient requirements. The Forest Service program to improve existing estimates of wood residues is outlined.

72 **Turning Farm Wastes into Usable Energy**

Zerbe, John I.

From: Cutting Energy Costs, the 1980 Yearbook of Agriculture, pp. 323-329

Agricultural biomass (generally waste materials) may be converted to more concentrated energy forms through chemical processes such as pyrolysis, a

chemical change brought about by the action of heat. The author discusses pyrolysis systems, gasification systems, storage potential, energy balances, and application on farms. He concludes that pyrolysis oil and methanol are front runners to substitute for fossil fuels.

73 **Assessment of Dilute Acid Hydrolysis of Cellulose**

Saeman, Jerome F.

From: Proc. Bio-Energy '80—World Congress and Exposition, pp. I62-164, Bio-Energy Counc., Washington, D. C., 1980

The potential of biomass as a source of ethanol has led to diverse and intense research on cellulose hydrolysis. Although most work is in early conceptual stages there is great demand for early assessment of available or imminent technology. The author discusses enzymatic hydrolysis, strong acid hydrolysis, dilute acid percolation, and two-stage dilute acid processes as approaches.

Wood Materials

74 **Cost of Manufacturing Structural Flakeboard Panel Products**

Harpole, George B.

From: The Role of Chemical Engineering in Utilizing the Nation's Forest Resources, pp. 57-67, George R. Lightsey, ed., Am. Inst. of Chem. Eng., Symp. Ser. No. 195, vol. 76, 1980

Harvested forests often contain much material uneconomical to process into lumber and plywood. Techniques for producing structural flakeboard products from such hardwood and softwood forest residues have been determined elsewhere. The analysis here estimated production costs for residues at nine northern and severn southern U.S. sites and compared these costs with likely market values of a product output.

75 **Racking Strength of Walls Sheathed with Structural Flakeboards Made from Southern Species**

Price, Eddie W. and David S. Gromala

For. Prod. J. 30(12):19-23, 1980

The Southern Forest Experiment Station has developed a structural flakeboard for external sheathing that has been tested by the Forest Products Laboratory for resistance to racking (in-plane shear). Lateral nail resistance was determined and full-scale and small-scale racking tests were correlated with lateral nail strength. Performance of these flakeboards was compared to that of southern pine plywood, a commonly used exterior sheathing material.

76 **Wood Diaphragm Materials**

McNatt, J. Dobbin and William L. Galligan

Proceedings of Workshop on Design of Horizontal Wood Diaphragms, pp. I7-49, Appl. Technol. Counc., Berkeley, Calif., 1980

Horizontal wood diaphragms, used as roofs or floors, are designed to resist such lateral forces as wind and earthquake loads. The primary elements that make up a wood diaphragm are the skin, the framing members, and the connections between the skin and framing members. Each of the materials which make up horizontal wood diaphragms is discussed here in some detail.

77 **Hardboard-Webbed Beams: Research and Application**

McNatt, J. Dobbin

For. Prod. J. 30(10):57-64, 1980

This paper discusses the suitability of hardboard as a shear-web material for built-up beams. The authors cover allowable stresses for structural use of hardboard, research studies on performance of hardboard-webbed beams, and examples of actual use as load-carrying members in building construction. The information was drawn from a review of the literature and from extensive correspondence.

Cooperative Research

Listed below are recent publications from universities or individuals involved in cooperative research with the Forest Products Laboratory. **Copies are not available from the Laboratory,** but may be obtained from the contacts listed following each publication.

Wood Energy in the United States

Hewett, Charles, C. High, N. Marshall and R. Wildermuth
In: 1981 Annual Reviews of Energy, Vol. 6

Annual Reviews, Inc., 4139 El Camino Real, Palo Alto, CA 94306

The Wood-Based Industry: Trends in Selected Structural and Economic Factors Through 1977

Bilek, Edward M. and Paul V. Ellefson
Staff Paper Series No. 22

Department of Forest Resources, College of Forestry & the Agricultural Experiment Station, Institute of Agriculture, Forestry & Home Economics, University of Minnesota, St. Paul, MN 55108

Effect of Input Costs, Economies of Scale, and Technological Change on International Pulp and Paper Prices

Buongiorno, Joseph and James K. Gilles
Forest Science 26(2), 1980

University of Wisconsin, Department of Forestry, Madison, WI 53706

New Wave of Structural Wood Panel Products

Hunt, Michael O.
In: Automation in Housing & Systems Building News, November 1980

Purdue University, Department of Forestry and Natural Resources, West Lafayette, IN 47907

Effect of Starch and Clay on Interfiber Bonding of Hardwood Pulps

Luner, P. and Cote, W.

Empire State Pulp & Paper Research Institute, Pulp & Paper Technology, SUNY College of Environmental Science and Forestry, Syracuse, NY 13210

Wetwood in Trees: A Timber Resource Problem

Ward, J. C. and W. Y. Pong
General Technical Report PNW-112, 1980

Pacific Northwest Forest and Range Experiment Station, 809 N.E. Sixth Avenue, Portland, OR 97232

Bacteriological, Chemical and Physical Properties of Wetwood in Living Trees

Ward, J. C. and J. G. Zeikus
In: Proceedings of IUFRO Working Party S.5.01-02, 1980

Kommissionsverlag, Buchhandlung Max Wiedebusch, Dammtorstr. 20, 2000 Hamburg 36 Germany

Mycorrhizal Development on Red Pine in Nursery Beds Treated with an Herbicide

Palmer, J. G., Sr., J. E. Kuntz, J. G. Palmer, Jr., and R. F. Camp
Forestry Research Note 240, 1980

University of Wisconsin, Department of Forestry, Madison, WI 53706

Finishing Exterior Plywood, Hardboard and Particleboard, Ext. Pub. No. 132
Paint Failure Problems and Their Cure, Ext. Pub. 133
Discoloration of House Paint—Causes and Cures, Ext. Pub. No. 134
Selection and Application of Exterior Finishes for Wood, Ext. Pub. No. 135
Finishing and Maintaining Wood Floors, Ext. Pub. No. 136

Cassens, Daniel L. and William C. Feist

Purdue University, Department of Forestry and Natural Resources, West Lafayette, IN 47097

Guidelines for Selecting Exterior Latex (Waterborne) Paints

Barquest, Glenn and William C. Feist

University of Wisconsin, Department of Forestry, Madison, WI 53706

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